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Tumor-Specific Hypoxia-Inducible Promoter/Enhancer Elements for  
Use in Gene Therapy

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## INTRODUCTION

The major objective of this research project was to identify and characterize promoter/enhancer elements that can be used to target the expression of therapeutic genes to hypoxic regions within prostatic tumors *in vivo*. Specifically, a novel episomal promoter/enhancer trap cloning system was developed and used to rapidly isolate candidate DNA sequences that were then tested both *in vitro* and *in vivo* for their functional activity in a variety of prostatic and other tumor cell lines under both normoxic and hypoxic conditions. Ultimately, adenoviral vectors in which expression of an indicator gene is driven off a candidate promoter/enhancer element will be constructed and tested for their ability to specifically target gene expression to hypoxic regions of prostatic tumor xenografts *in vivo*.

## BODY/PROGRESS

### **Task 1:** Isolation and characterization of novel "prostate-specific" hypoxia inducible promoter/enhancer elements

Initial efforts directed toward isolating and characterizing novel "prostate-specific" hypoxia-inducible promoter/enhancer elements for use in various cancer gene therapy applications utilized pEGTIII, a unique episomal promoter/enhancer expression vector that was developed in our laboratory. This vector contains a "leaderless" bone/liver/kidney alkaline phosphatase cDNA (ALP) that has been engineered to express a widely utilized splice acceptor site derived from CD44 exon v9 at its 5' end. Randomly generated size-selected (mean size around 2.5 kb) DNA fragments were cloned upstream of this indicator gene creating a plasmid library of moderate complexity ( $\sim 10^7$  recombinants). Upon transfection into an appropriate eukaryotic target cell, expression of ALP will only occur if the DNA fragment present in the plasmid vector contains both an appropriate promoter/enhancer element and an exon that can provide a splice donor site that can be utilized to generate an in-frame fusion protein. The vector also contains the EBNA-1 gene and an EBV origin of replication (oriP) and as such is expected to replicate episomally within the nucleus of transfected cells giving approximately 20-30 copies/cell. Such amplification is a potentially important aspect of the cloning strategy as it may allow the identification of promoter elements with weak constitutive activity that can then be excluded from further consideration potentially favoring the isolation of inducible promoters that are inactive in the absence of appropriate stimulation.

In initial "proof-of-principle" studies, the plasmid library was introduced into various prostatic (DU145, PC3, LnCap) and non-prostatic (293, T24, K562) tumor cell lines by electroporation. Forty-eight hours later, G418 was added at a final concentration of 200-400  $\mu\text{g}/\text{ml}$  to select for transfected cells. Plates were then cultured for 18-21 days during which time discrete colonies containing 100-200 cells are produced. Colonies composed of cells transfected with a plasmid encoding a constitutively active promoter element could be readily identified by virtue of their expression of ALP. Briefly, plates were fixed for 1 minute in 100% ethanol then incubated for various periods of time with

the ALP substrate BCIP/INT. As shown in Figure 1, ALP-positive colonies stain an intense brown color and can be easily differentiated from ALP-negative colonies. The frequency of ALP-positive colonies (indicating the presence of constitutively active promoter elements) was, however, disappointingly low (~0.1%). Moreover, attempts to recover plasmid DNA from fixed ALP-positive colonies by scraping the cells from the dish and performing Hirt extraction were unsuccessful despite our considerable experience with the approach and the expenditure of much time and effort.

In an attempt to overcome this potentially serious obstacle to further progress we developed a novel colony lift technique that permits the identification of ALP positive colonies without the requirement that plates be first fixed in ethanol. Since the colonies remain viable, they can be picked and expanded for subsequent promoter isolation and characterization studies. Briefly, plates are washed extensively to remove medium then incubated in PBS for 20 minutes. Since PBS lacks calcium and magnesium ions the cells in the colonies round up and loosen their attachment to both the substrate and one another. At this point plates are overlaid with Immobilon-P PVDF membranes and incubated for 5 minutes at room temperature. A proportion of the cells present in each colony are bound by the membrane which is then removed, fixed in ethanol and stained for ALP expression using the ALP substrate BCIP/INT as before. Colonies that express ALP, presumably because they were transfected with a plasmid containing a promoter/enhancer element that is constitutively active in the cell type under study, can be readily identified by virtue of the presence on the membrane of a brown staining "plaque". The position of such colonies on the original plate can then be marked, fresh media added and the cells cultured for a further 48 hours to allow recovery. At this point, ALP-positive colonies can be picked and the clones expanded *in vitro* prior to further study. It was possible using this approach to establish a panel of cell lines that differ greatly in ALP expression, presumably reflecting differences in the activity of the constitutive promoter elements they contain. Examples of two such lines are shown in Figure 2. Although most of the colonies that were picked for further analysis in the course of this study were uniform in their expression of ALP and gave rise to cell lines that were essentially 100% ALP positive, occasional clones were observed in which only a small proportion of cells within the original tumor colony stained for ALP. Particularly common was a presentation where only the cells at the edge of a colony were strongly ALP positive. It is conceivable that the promoter element present within the pEGTIII plasmid with which these cells were transfected is active at only certain stages in the cell cycle or is regulated by signals associated cellular differentiation, activation, migration etc.

Unfortunately, despite exploring a large number of variations on the standard procedure that has served us well with respect to other episomal plasmids (e.g. pCDM8), attempts to isolate pEGTIII plasmid DNA from viable ALP-positive cells by Hirt extraction once again proved unsuccessful. In order to explain this finding, Southern blot analysis was carried out. These studies demonstrated unequivocally that in most of the established ALP-positive cell lines selected and maintained in G418, the pEGTIII vector was no longer episomal but rather, that one or more copies of the plasmid had instead integrated into the genome (data not shown). In those cell lines where episomal DNA

could be detected, copy number was generally very low (<5 copies/cell) and integration into the genome was usually also evident. Obviously, integrated plasmids will not be recovered by Hirt extraction and in those cells that do contain episomes copy number may be below the threshold required for efficient recovery of plasmids even when starting with a very large number of viable cells. Promoters could of course be isolated from ALP-positive cells by PCR using primers that flank the cloning site present in the pEGTIII vector. This was, however, not a particularly efficient process and is certainly not one that lends itself to high throughput screening. Indeed, for those cell lines in which only integrated plasmids are evident, a simple PCR approach employing primers that flank the pEGTIII multiple cloning site was rarely successful. This finding may reflect the fact that the recombination event that gives rise to stable integration may occur preferentially within the region of the plasmid that contains the genomic DNA insert.

Given the limitations of the pEGTIII approach discussed above, various alternative promoter-cloning strategies were explored. The most promising employed a plasmid vector designated pEpiNPT that was obtained from an industrial collaborator under a confidentiality agreement. As shown in Figure 3, this particular vector is similar in some respects to our pEGTIII plasmid as both are EBV-based and designed to replicate episomally within the nucleus of transduced cells. However, rather than using leaderless-ALP as an indicator gene, the pEpiNPT vector instead contains a cassette in which the neomycin resistance gene (NPT) is placed immediately downstream of a simple minimal promoter containing an appropriately positioned TATA box and transcriptional start site. A library is generated by cloning random genomic DNA fragments (mean insert size 3.5 kb) into a multiple cloning site adjacent to the minimal promoter. Since the minimal promoter itself lacks significant constitutive activity, resistance to G418 upon introduction of the library into an appropriate target cell line only occurs if the genomic DNA fragment present in a particular clone possesses the necessary complementing activity. The promoter elements isolated using this approach are thus artificial hybrids in that neither the minimal promoter or the corresponding genomic DNA fragment are expected to possess promoter activity in their own right but only when joined to one another. Initial screening indicated that a surprisingly high 10-12% of clones present within a library provided by our collaborator exhibited a level of promoter activity sufficient to confer resistance to G418 upon introduction into a range of prostatic and non-prostatic tumor cell lines. These results appeared very promising and encouraged further development of this alternative vector system. However, given the difficulty we had experienced previously in recovering plasmid DNA from cells transfected with the pEGTIII vector that had been selected and maintained for long periods of time in G418, it was felt necessary to develop an alternative transient screening strategy. Various approaches were explored but in the one that worked best, the NPT gene present in the pEpiNPT vector was removed and replaced with GFP allowing promoter activity to readily determined and quantified by FACS analysis. This vector was designated pEpiGFP. As shown in Figure 3, a second expression cassette was included in subsequent versions of this vector allowing transfected cells to be identified and/or selected. To permit cost effective high throughput analysis, a system was developed in which individual plasmid clones were isolated and introduced into



adherent tumor cells growing in the wells of a 96 well plate using either an 8 or 96 well electrode and two days later individual wells were harvested by trypsinization and any cells expressing GFP identified by FACS analysis. As illustrated in Tables I and II and Figure 4, considerable effort was expended in determining the most appropriate custom electrode design (i.e. conventional versus reverse polarity) as well as the optimal electroporation conditions necessary to obtain efficient gene transfer into a range of tumor cell lines. Although the efficiencies obtained were generally somewhat less than is seen for cuvette-based electroporations, a range of conditions were ultimately identified in which both the level of GFP expression and the percentage of GFP-positive cells obtained were deemed adequate to permit screening of the pEpiGFP library (Figure 4). Although labor intensive, this approach has lead to the identification of a number of promoter elements (~0.5% of the clones screened) that are constitutively active in prostatic and/or other tumor cell lines. Of these, a total of four elements were considered of particular interest as a result of their high activity and/or cellular specificity. As shown in Figures 6-8, these elements have been sequenced, their chromosomal locations defined and various potentially important structural elements identified. Details are provided in the corresponding Figure Legends. Particular interest was focused on promoter 780 by virtue of its differential activity in the prostate cell lines DU145 and PC3 (Table III). Initial deletional analysis of this promoter was carried out in order to narrow down the region responsible for its constitutive activity (Figure 9). Removal of the 5' end of the sequence (Kpn $\Delta$  and Xba $\Delta$ ) significantly enhanced activity suggesting the presence within this region of inhibitory/suppressive elements. Activity declined as addition 5' sequences were removed although even a 1103 bp Xho1 fragment that encompasses the 3' end of the promoter retained moderate activity. Of course even this relatively short sequence contains numerous putative transcription factor-binding sites as determined using the MatInspector v2.2 program accessed via the TRANSFAC Transcription Factor Database (<http://transfac.gbf.de/TRANSFAC/>). Ultimately additional deletional analysis will need to be carried out before site-directed mutagenesis can be used to identify the precise sequence elements responsible for the constitutive activity of this and other interesting promoter elements in prostatic tumor cells.

Both ourselves and the various collaborators to whom we have supplied reagents have begun the process of screening the pEpiGFP library using the same basic approach described above in order to identify promoter clones that are responsive to hypoxic stimuli. Since it was appreciated that the fluorescent activity of GFP is dependent upon the presence of O<sub>2</sub>, cells were allowed to recover for various periods of time under normoxic conditions before analysis. Although several potentially promising prostate-specific and/or hypoxia-responsive promoter candidates were identified, to date none of these have withstood more rigorous analysis although screening studies are continuing.

**Task 2:** Characterization of the functional activity of candidate promoter/enhancer elements in prostatic tumor cells *in vitro* and *in vivo*

An important objective of this task was to characterize the functional activity of candidate hypoxia-inducible promoter elements in tumor spheroids that contain regions of diffusion-limited hypoxia. To this end we developed an approach in which highly reproducible tumor spheroids are established in hanging droplets in the wells of a Terasaki plate.

Since the promoter cloning work described above has not yet lead to the identification of novel elements that meet the stringent criteria for cellular specificity and responsiveness to hypoxia set out in the original proposal, initial functional studies focused instead on a 1399 bp genomic DNA fragment corresponding to a region of the human TNF- $\alpha$  promoter (position -1307 to +92) (Figure 10) that has been isolated, cloned into a modified version of the pEGTIII vector containing a full-length ALP cDNA (pEGTIV) and shown to possess both low constitutive activity and good induction following 18 hour incubation of transfected K562 cells (erythroleukemia) in a low O<sub>2</sub> environment. Unfortunately, in some prostatic and other epithelial cell lines, although significant induction was also obtained following exposure to hypoxia and/or other stimuli (see initial application), the TNF- $\alpha$  promoter exhibited high constitutive levels of activity that may limit its usefulness in targeted gene therapy applications (Table III). Initial stepwise deletional analysis determined that much of this constitutive activity could be attributed to a sequence located within a ~100 bp region immediately upstream of the TATA box (Figure 10). As shown in Figure 11, more targeted deletion of this short region while retaining the remainder of the promoter intact reduced constitutive activity by 80-90%. Individual transcription factor binding sites located within this region were then targeted using a PCR-based site-directed mutagenesis approach and in this way, the AP1 site located at position -108 was shown to play a critical role in the determining the constitutive activity of the promoter in non-myeloid cells. When placed upstream of a GFP indicator gene a "full length" TNF- $\alpha$  promoter in which this site was rendered nonfunctional by site-directed mutagenesis exhibited minimal background activity. Using this construct as a starting point, additional deletional analysis is being carried out to define the sequence motif(s) responsible for the observed hypoxia-induced activity of the TNF- $\alpha$  promoter. Particular emphasis is being placed on the three NF- $\kappa$ B sites shared by both the human and mouse TNF- $\alpha$  genes (Figure 10) as changes in redox potential resulting from irradiation or exposure to hypoxic conditions induce activation of NF- $\kappa$ B and tyrosine phosphorylation of its inhibitory subunit I $\kappa$ B $\alpha$  via a signal transduction pathway that involves Ras and Raf, but not MAP kinase. Moreover, recent studies have shown that interaction between NF- $\kappa$ B and the  $\kappa$ 3 site located toward the 3' end of the promoter plays an important role in the transcriptional activation of TNF- $\alpha$  by superantigen. In contrast, studies with the monocytic cell line Mono Mac 6 indicate that LPS induces a factor with the characteristics of NF- $\kappa$ B that interacts with  $\kappa$ 1, the most 5' of the three NF- $\kappa$ B binding sites in the promoter.



**Task 3:** Generation and analysis of adenoviral vectors in which expression of an indicator gene is driven off candidate hypoxia-inducible, prostate-specific promoter elements

Several adenoviral vectors have been generated in which expression of various indicator genes is driven off a number of the constitutive promoter elements examined in the course of the present study. Rather than using the approach outlined in the initial proposal, these vectors were constructed using the AdenoQuest Kit manufactured by QBio (Montreal), as the design of the "transfer" vector included in this kit facilitates the direct subcloning from pEGT or pEpi vectors of a cassette that includes the promoter of interest, an indicator or therapeutic gene and an SV40-derived polyadenylation signal. Initial studies have confirmed that, with the exception of PC3, which appears to express low levels of CAR, prostatic tumor cells can be efficiently transduced *in vitro* using such adenoviral vectors. Studies to evaluate the potential effectiveness of adenoviral-mediated gene transfer in the treatment of prostate cancer are currently being carried out by ourselves and various collaborators using a number of *in vivo* tumor models. The initial data from one such study is shown in Figure 12. In this experiment, DU145 tumor xenografts growing subcutaneously in SCID mice were directly injected with an adenoviral vector in which a constitutive promoter is used to drive expression of a chimeric gene encoding a cell surface protein consisting of the extracellular domain of the VEGF receptor Flk-1 fused in frame to the membrane spanning and cytoplasmic domain of the pro-apoptotic protein Fas. It is hypothesized that crosslinking of the Flk/Fas chimera by VEGF produced within the tumor microenvironment in response to hypoxia or other stimuli will trigger an apoptotic response in transduced cells. 24 hours after adenoviral administration, tumors were treated with photodynamic therapy (PDT) and the effect of adenoviral transduction on tumor regrowth determined. Even at the relatively low dose of virus used in these initial experiments some reduction in tumor regrowth is evident.

**KEY RESEARCH ACCOMPLISHMENTS:**

- Development of a novel high throughput screening strategy that can be used to rapidly isolate promoter elements that are constitutively active in a cell type of interest or responsive to a particular stimulus *in vitro*.
- Isolation and characterization of a panel of promoter elements that exhibit constitutive activity in prostatic tumor cells.
- Identification and preliminary characterization of promoter elements that exhibit differential activity in certain prostatic tumor cell lines.
- Identification of the transcription factor binding sites present within the human TNF- $\alpha$  promoter responsible for constitutive activity in transfected prostatic tumor cells.

-Generation of preliminary evidence that treatment with adenoviral vectors in which expression of a therapeutic gene (Flk/Fas) is driven off constitutive promoter elements can inhibit the growth of prostatic tumor xenografts *in vivo*.

#### **REPORTABLE OUTCOMES:**

Manuscripts will be submitted describing the characterization of the transcription factor binding sites present within the human TNF- $\alpha$  promoter that are responsible for constitutive activity and hypoxia responsiveness. The support of the US Army Medical Research and Materiel Command will be acknowledged.

The sequences of the novel promoter elements identified in this study will be submitted to GENBANK.

Aliquots of the pEGTIII and pEpiGFP libraries have been provided to colleagues in the US, Canada and the UK who are interested in identifying promoter elements that respond to a variety of stimuli including, hypoxia, radiation and tubulin-binding agents. We are actively involved in the planning and execution of these studies and will be included as authors on the resultant publications.

#### **CONCLUSIONS:**

Although the promoter cloning studies carried out to date have failed to identify a promoter element that is both prostate-specific and hypoxia-inducible, a high throughput screening strategy that will allow such sequences to be isolated has been developed and a number of potentially interesting constitutive promoter elements, some of which show differential activity in various prostate tumor cell lines, have been obtained. Screening studies are continuing and we are optimistic that therapeutically useful elements meeting the strict functional requirements outlined in the initial proposal will ultimately be identified and characterized using this approach.

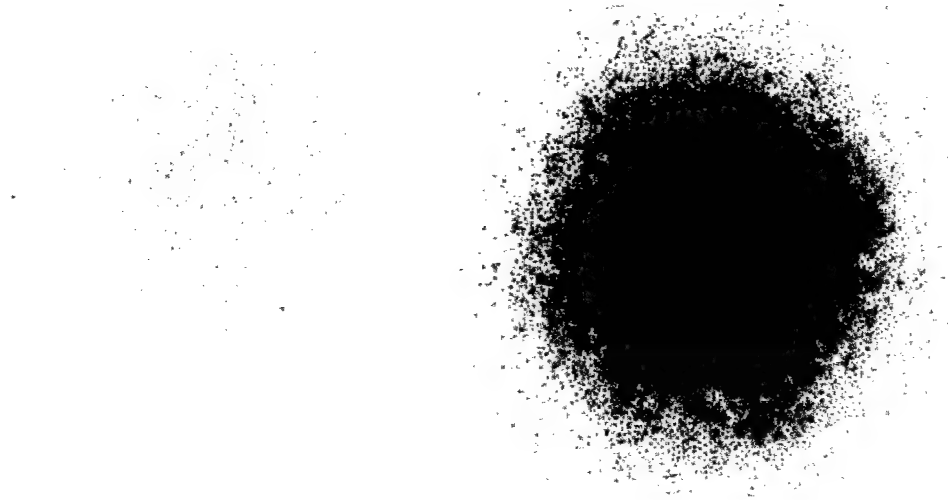
#### **REFERENCES:**

N/A

#### **APPENDICES:**

Figures 1-12 and Tables I-III attached in Appendix 1.

## FIGURE 1



**Figure 1:** Identification of promoter elements active in prostatic tumor cell lines. The pEGTIII plasmid library was introduced into various prostatic (DU145, PC3, LnCap) and non-prostatic (293, T24, K562) tumor cell lines by electroporation. Forty-eight hours later, G418 was added at a final concentration of 200-400  $\mu\text{g/ml}$  and the plates cultured for 18-21 days to select for transfected cells which gave rise to discrete colonies containing 100-200 cells. To determine ALP expression, plates were fixed for 1 minute in 100% ethanol then incubated for various periods of time with the ALP substrate BCIP/INT. As shown in the right hand panel above, colonies that are ALP-positive (presumably because the plasmid with which they were transfected contained a constitutively active promoter) can be readily detected by virtue of their intense brown staining and can be easily differentiated from ALP-negative colonies, an example of which is shown in the left hand panel. Irrespective of the cell line tested, the frequency of ALP-positive colonies produced was around  $\sim 0.1\%$ .

**FIGURE 2**



**Figure 2:** Variations in ALP expression by established cell lines derived from pEGTIII transfected ALP-positive tumor cell colonies. ALP-positive tumor cell colonies identified using the colony lift technique described in the text, were picked and expanded *in vitro*. As illustrated by the two T24 clones shown above, the populations obtained differ greatly in their expression of ALP as determined by BCIP/INT staining of ethanol fixed cells adherent to glass coverslips. Such heterogeneity can be attributed at least in part to differences in the activity of the particular constitutive promoter element that is present within the pEGTIII plasmids with which the cells were initially transfected.

FIGURE 3

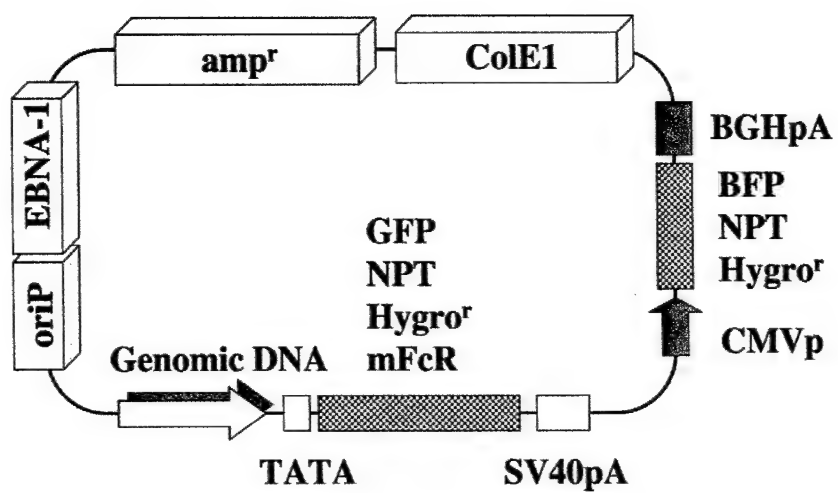


Figure 3: Key features of the pEpi promoter cloning vector series



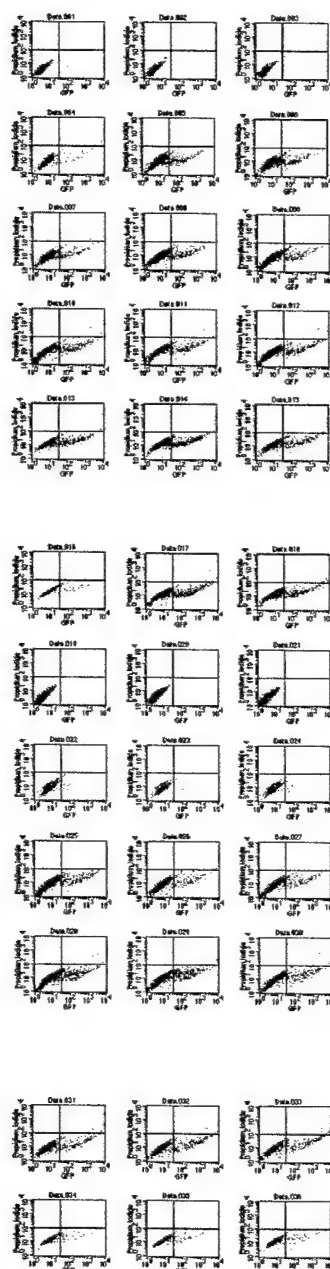
**TABLE I:** Determining optimal electroporation conditions for "conventional" 8/96 well electrode.

Sample #	$\mu\text{F}$	%viable	$\bar{x} + \sigma^{n-1}$	%GFP +ve	$\bar{x} + \sigma^{n-1}$	$\bar{x}$ FL-1	$\bar{x} + \sigma^{n-1}$
Data 001	NIL	97.72		0.08		N/A	
Data 002	NIL	98.00	97.7+0.2	0.06	<0.1	N/A	N/A
Data 003	NIL	97.52		0.02		N/A	
Data 004	50	39.72		5.69		424	
Data 005	50	56.72	49.8+8.9	10.17	8.8+2.7	269	328+84
Data 006	50	52.82		10.49		290	
Data 007	100	49.57		9.62		312	
Data 008	100	47.04	48.7+1.4	11.82	10.6+1.1	314	312+2
Data 009	100	49.48		10.43		311	
Data 010	200	48.50		12.45		541	
Data 011	200	41.64	45.7+3.6	15.05	14.0+1.4	470	516+40
Data 012	200	47.10		14.52		536	
Data 013	400	38.88		17.57		444	
Data 014	400	43.16	39.8+3.0	20.25	19.0+1.4	549	514+61
Data 015	400	37.38		19.21		549	
Data 016	800	15.08		6.5		248	
Data 017	800	39.94	31.6+14.3	20.47	14.3+7.1	596	440+177
Data 018	800	39.62		15.96		475	

**TABLE II:** Determining optimal electroporation conditions for "reverse-polarity" 8/96 well electrode.

Sample #	$\mu\text{F}$	%viable	$\bar{x} + \sigma^{n-1}$	%GFP +ve	$\bar{x} + \sigma^{n-1}$	$\bar{x}$ FL-1	$\bar{x} + \sigma^{n-1}$
Data 019	NIL	96.66		0.00		N/A	
Data 020	NIL	96.58	96.0+0.1	0.00	<0.1	N/A	N/A
Data 021	NIL	94.90		0.00		N/A	
Data 022	50	24.32		1.32		49	
Data 023	50	16.00	22.74+6.1	0.50	0.9+0.4	55	53+3
Data 024	50	27.90		1.00		54	
Data 025	100	55.68		13.25		546	
Data 026	100	46.96	51.1+4.4	13.81	12.9+1.1	400	476+73
Data 027	100	50.78		11.59		482	
Data 028	200	53.90		14.99		375	
Data 029	200	53.0	54.1+1.2	18.39	16.2+1.9	397	431+78
Data 030	200	55.35		15.36		520	
Data 031	400	36.19		17.10		247	
Data 032	400	40.44	37.5+2.6	21.19	20.9+3.7	635	551+272
Data 033	400	35.79		24.43		771	
Data 034	800	24.45		8.10		301	
Data 035	800	25.11	24.4+0.8	6.67	9.2+3.2	165	287+116
Data 036	800	23.53		12.78		395	

### FIGURE 4



**Figure 4:** Determination of optimal conditions for electroporation of tumor cells in flat-bottomed 96 well plates. 10 ml of a 293 cell suspension ( $1 \times 10^5$  cells/ml) were added to 100  $\mu$ l pEpiGFP(CMV) plasmid DNA (1 mg/ml), mixed well and 100  $\mu$ l aliquots added to each well of a flat-bottomed 96 well plate ( $1 \times 10^4$  cell/well). Wells were electroporated at 280v, R3 (48 Ohms) at capacitance

settings of 50, 100, 200, 400 and 800  $\mu$ F using a BTX electroporator and the time constants were recorded (see Tables I & II). Immediately after electroporation, 100  $\mu$ l DMEM+20% FCS were added to each well and the plates incubated at 37°C, 5% CO<sub>2</sub> for 3 days. To determine GFP expression, any non-adherent cells were collected, wells trypsinized and the adherent and non-adherent populations pooled. Cells were pelleted by centrifugation at 1000 rpm for 10 min, resuspended in 750  $\mu$ l HBSS+2% FCS containing 1  $\mu$ g/ml propidium iodide (PI) and analyzed on a FACSCalibur. Non-viable PI-positive cells were gated out and data collected on the percentage viable (PI-negative) cells, the percentage of viable cells expressing GFP and the mean fluorescence of GFP-positive viable cells. The dot plots obtained are attached and the data is summarized in Tables I & II. Data 001-018: Conventional electrode. Data 019-036: Reverse polarity electrode.

## FIGURE 5

1 agactgtaat cagtcogtat tgggagaaaa aaaatcattt gtggaacagt tcaaatgcca atgactatag  
 tctgacatta gtcaggcata accctctttt ttttagtaaa caccttgta agtttacggt tactgatatac  
 71 tttttccag ctctgaaaaa aaaaaagaag taactagaaa tgaattatgt taagtacta actgaatttc  
 ataaaaggtc gagacttttt tttttcttc attgatcttt acttaataca attcaatgat tgacttaag  
 141 ttctgaaatc occagaaact gaacaagaga tcagagatgt tttgtgggtt tctttttgaa gtoaatcaaa  
 aagacttttag gggcttttga ctgtttctct agtctctaca aaacacccaa agaaaaactt cagttagttt  
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 taaataggta atcggaaaaa aaagaggagg tgggttccag ttgtttacgt ttccaaacta agacctacct  
 421 gttcatttgg atgtgtcacc aggaagggtt tcttagcatt gcaggctgcc gaaatttga agaattccacc  
 caagtataac tacacagtgg tcttcccat agaactgtaa cgtccgacgg ctttaaacct tcttaggttg  
 491 ctcatgtatt gtctttgttc ttgtctggtt tacacagcaa atatagtga atatctgac tgcaaggcca  
 gagtaactaa cagaaacaag aaacgaccaa atgtgtcgtt tatatcacct tatagactag acgttccggt  
 561 gacatataaa taatttcacc ttttcagtg cagttgaagg cctaaccat agcaaagta ctaagaaaa  
 ctgtatattt attaaagtg aaaaagtcacc gtcaacttcc ggattagta tcttttcaat gatttctttt  
 631 agttttatag gtatttagtt ttttcccatg ttttctgtat cattttactc ctaattaaat ctctcacctc  
 tcaaaatatc cataaatcaa aaaagggtac aaaagaacta gtaaaatgag gattaattta gagagtggag  
 701 attgctgata ttaagaatgg tggtaggaat aatttttagcc tttgggtttt gttgattgat ttaaaaatga  
 taacgactat aattcttacc accatcctta ttaaaatcgg aaacccaaaa caactaacta aatttttact  
 771 caaggttttt gttagttatt ctgactagcc cttaaattat tatttttagaa agtgctttct cgttgtctga  
 gttccaaaaa caatcaataa gactgatcgg gaatttaata ataaaactt tcacgaaaga gcaacagact  
 841 tgatttgaga agtgccctga aaaaaacaa aggtattcct catgctgtgg ttaaatggaa gctgagatct  
 actaaactct tcaccggact tttttttgtt tccataagga gtacgacacc aatttacctt cgaactctaga  
 911 gccaatcaat ccttatctac caaatttaat ttagaacatt gtgttcttcc atatctaaaa tagcataaat  
 cggttagtta ggaatagatg gtttaaatat aatcttgtaa cacaagaagg tatagatttt atcgtattta  
 981 ttagcaatc cactctttt cacagtgtg ttatgttttag tttatgaaaa ttatatattt ttgaaaaatt  
 aatcgttatg gtatgaaaaa gtgtcactac aatacaaatc aaatactttt aataataaaa aactttttta  
 1051 agcattatat ttcaattcta cttttactgt cattatgaga ggtgacagcg tgctggcagt cctcagagcc  
 tcgtaataata aagttaagat gaaaatgaca gtaatactct ccactgtcgc acgaccgtca ggagtctcgg  
 1121 ctgctgtgct ctacgacct cccctgcctg ggctccact ttggtggcat ttgaggagcc cttcagtcct  
 gagcgaaacga gagtctgtga ggggacggac ccgaggggtga aaccaccgta aactcctcgg gaagtccagg  
 1191 ccactgcact gtgggagccc ctttctgggc tggccaaggc tggagccac tcccttagcc tgcaggagg  
 ggtgacgtga caccctcggg gaaagaccg accggttccg acctcgggtg agggaaatcgg acgtccctcc  
 1261 tgtggaggga gaggcgcgag tgggaaccgg ggctgcaggt ggagctgcct gccagtcctg cgcgtgcac  
 acacctccct ctccgcgctc acccttggcc ccgacgtcca cctcagcga cggtcagggc ggggacgtg  
 1331 tcgcatctct cagcccttgg gtggtcgatg ggactgggtg ccgtggagca ggggtgtgtg ctctcgagg  
 agcgtaaaga gtcgggaacc caccagctac cctgacccac ggcacctcgt ccccccaccac gagcagctcc  
 1401 aggcctgggc ggcacaggag cccacggagg agggggaggc tcaggcatgg cgggtgcag gtccaaagcc  
 tccgagccc cgtgtcctc ggggtcctcc tccccctcc agtccgtacc gcccgacgtc cagggttcgg  
 1471 ctgccccacg ggaaggcagc taaggcccg cgagaatcg ggcacagcg cgggtggcg gcactgctgg  
 gacgggggtg ccttcctgct attccgggac gctcttttag ccgtgtcgc gccacccggc cgtgacgacc  
 1541 gggactcagt acactggcg cttgcccggc agctggagtt ccgggtgggc atgggcttgg tgggcccctg  
 ccctgagtc tgtggacgc gaacgcccg tcgacctcaa ggcccaccg tacccgaacc acccggggac



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1611 cactcggagc agccagccag ccctgctggc cccgggcaat gggggactta gcacctgggc cagtggctgt
    gtgagcctcg tgggtcggtc gggagcagcg gggcccgtta cccctgaat cgtggaccgg gtcaccgaca
1681 ggagggtgta ctgagtcccc cagcagtgcg gggccaccgg cgctgtgccc gatttctcgc cgggccttag
    cctcccacat gactcagggg gtcgtcacgg ccgggtggcc gcgacacggg cttaaagagcg gcccggaatc
1751 ctgccttccc gtggggcagg gcttgggacc tgcagcccgc catgcctgag cctccccctc ctccgtgggc
    gacggaaggg caccocgtcc cgaaccctgg acgtcgggcg gtacggactc ggagggggag gaggcaccgg
1821 tcctgtgcgg ccgagccctc ctcgacgagc accacccctt gctccacggc acccagtcctc atcgaccacc
    aggacacggc gggctcggag gagctgctcg tgggtgggga cgaggtgcgg tgggtcaggg tagctggtgg
1891 caagggtgta ggaatgcgag tgcacggcgc gggactggca ggcagctcca cctgcagccc cggtgtggga
    gttcccgact cttacgctc acgtgcgcgg ccctgaccgt ccgtcgaggt ggacgtcggg gccacaccct
1961 tccactgggt gaagccagct gggctcctga gtctgggtgg aatgtggaga gtctctatat ctactcaggg
    aggtgaccca ctctcggtcga ccgagggact cagaccaccc ttacacctct cagagatata gatcgagtc
2031 gattgtaaat acaccaatca gcacctgtg tttagctcaa ggtttgtgag tgcaccaatt gacactctgt
    ctaacattta tgtggttagt cgtgggacac aaatcgagtt ccaaactc acgtggttaa ctgtgagaca
2101 atctagctgc tctggtgggg ccttggagaa cctgtgtgtc tagctcaggg attgtaaata caccaatcgg
    tagatcgagc agaccacccc ggaacctctt ggacacacag atcgagtccc taacatttat gtggttagcc
2171 cactctgtat ctactcgaac gtttgtaaac acaccaatca gcacctgtg tttagctcaa ggtttgtgag
    gtgagacata gatcgagttg caaacatttg tgtggttagt cgtgggacac aaatcgagtt ccaaactc
2241 tgcaccaate gacactctgt atctagctgc tctggtgagg atgtggagag tctttatata tagctcaggg
    acgtggttag ctgtgagaca tagatcgagc agaccactcc tacacctctc agaaatatag atcgagtccc
2311 attgtaaaca caccaatcag caccctgtgt ttagctcaag gtttgtgagt gcaccaatcg aactgtatc
    taacatttgt gtggttagtc gtgggacaca aatcgagttc caaacactca cgtggttagc tgtgacatag
2381 tagctgctct ggtgaggaca tggagaacct ttatgtctag ctcaaggatt gtaatacac caatcgccac
    atcgacgaga ccaactcctg acctcttggg aatacagatc gagttcctaa catttatgtg gttagccgtg
2451 tctgtatcta gctcaaggtt tgtaaacaca ccaatcagca cctgtgttt agctcaaggt ttgtgagtc
    agacatagat cgagttccaa acatttgtgt ggttagtcgt gggacacaaa tcgagttcca aactcagc
2521 accaatcgac actctgtatc tagctgctct ggtggggcct tggagaacct gtgtgtgaa actctgtatc
    tgggttagctg tgagacatag atcgacgaga ccaccccgga acctcttggg cacacacctt tgagacatag
2591 taactaatct gatggggagc tggagaacct ttgtgtctag ctcaaggatt gtaaacgcac caatcagcg
    attgattaga ctacccctgc acctcttggg aacacagatc gagtccttaa catttgctg gttagtcgg
2661 cctgacaaaa caggccactc ggctctacca atcagcagga tgtgggtggg gccagataag agaataaaag
    ggactgtttt gtccggtgag ccgagatggt tagtcgtcct acaccacccc cgggtctatc tcttattttc
2731 caggctgcgg gaaccagcat tggcaaccca ctcgagtccc cttccacctc gtggaa
    gtccgacggc cttggtcgta accgttgggt gagctcaggg gaaggtggag cacctt

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**Figure 5:** Complete sequence of pEpiGFP promoter clone #648. Maps to human Chromosome 6. Matches nucleotides 10084-12869 of Genbank Accession [gi|9581538|emb|AL135912.7|9581538](#). Potentially important features noted within this region of chromosome 6 include a CpG island at position 11358-12004, an endogenous retroviral LTR12 element at position 12618-13250 and three pTR5 repetitive elements (an endogenous retroviral sequence that is present in human but not baboon DNA) at positions 11169-11398 (matches 743-963 of consensus sequence), 11372-11638 (matches 1074-1345 of consensus sequence) and 11609-12610 (matches 926-1907 of consensus sequence).

# FIGURE 6

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1  aagcttgccct ccttctcccc gcagtggcca ggacaaggct cacatttttc tgttctctgt ctccccagcc
   ttcgaacgga ggaagagggg cgtcaccggt cctgttccga gtgtaaaaag acaagagaca gaggggtcgg

71  ctctcctggg ctttctcccg gtgcaatgac accttcactt cctgtttggt cccattctct ggggtggctg
   gagaggaccc gaaagagggc cacgttactg tggaagtaga gggacaacca gggtaagaga cccaccgac

141 gaggtggcct gggatgtctc ggtccagtgc aggtgggctt ggggactctt ccgtacctca cttctccctg
   ctccaccgga cccatcacgag ccaggtcacg tccaccgcga cgcctgagaa ggcattggagt gaagaggagc

211 cacctgtggc cctgtctatc ggcgtgttta ctggagatgc gattcccctc ttccttcttt gttcaggtag
   gtggacaccg gggacgatag ccgcacgaat gacctctacg ctaaggggag aaggaagaaa caagtccatc

281 cagggcccaa gaaaaatcgt cttttatgga aggcatacag caagaaattt gataggcatt ctcttctctc
   gtcccggggt ctttttagca gaaaatacct tccgtagtgc gttcttttaa ctatccgtaa gagagtgag

351 tagaaatcag ccccggtggga caggggtctt gccctttatt ctctgacagc ggcagctcc tagggcacgc
   atctttagtc ggggcaccct gtcccagaa cgggaaataa gagactgtcg ccggtcgagg atcccggtcg

421 ttggtgcctg gggacactca acagggagat gctttctctg tgtcaataga cttactcat ggactcagtc
   aaccacgcac ccctgtgagt tgtccctcta cgaaagagac acagtatct gaagttagta cctgagtcag

491 gttcgccata aaatagattc caaatgggtg gaaactcata ggacagtggg ttggcacaaa agcgtgcttg
   caagcggatt tttatctaag gtttaccac ctttgagtat cctgtcacca aaccgtgttt tcgcacgaac

561 ttggtggttt taaaactaag tcgcgaaatt gatacactgc tgtgtgatac accagaaagt ggtccgttcc
   accgacaaaa attttgattc agcgttttaa ctatgtgacg acacactatg ttggtcttca ccaggcaagg

631 atccaccgcc gcaagtgtct gtcacacaga ggttagttct ttcataaaac tttattacgt atcgaacccc
   taggtgggag cgttcacaga cagtgtgtct ccaatcaaga aagtattttg aaataatgca tagcttgggg

701 attactcttc ctgaatctgt ttcaggaagg atgtgtgctg gtgaagagga tgagcgaagg cctgccttcc
   taatagtagt gacttagaca aagtccttcc tacacacgac cacttctcct actcgttcc ggacggaagg

771 tgaagctcga gcgtcatag ggaagatgtt ccgtaaacaa agaaacacgc atggagcatg tcattgtccc
   acttcgagct cgcgagtatc ccttctacaa ggcatttgtt tcttctgtcg taacctctac agtacagggg

841 atgtggagag agccacggag cacagggggc cgggaggggc tggatgcgcc agtgccagc ttggggaagg
   tacacctctc togtgtcctc gtgtccccc gccctccccc acctacgcgc tcaccggtcg aacctctcc

911 cctctcttgg ggccttctcc tttggtcctt ggagtctaaa acttctgtgt gtccttcttg cctgcctagc
   ggagagaacc ccgaaggagg aaaccgagga cctcagattt tgaaggacca cagggagac ggacggatcg

981 agaacccttc cacacggctc ccgtctaa ggcgcaggga tgagctgtgt ggatgctgct gagactgggtg
   tcttggggag gtgtgcccag gggcagattc cgccttccct actcgacaca cctacgacga ctctgaccac

1051 tgactgcttt gacgttctgc cactgatgca gcacctgcag ggtgccggcc gccccagcaa ggacacacca
   actgacgaaa ctccgaacag gtgactacgt cgtggacgtc ccacggcgcc cggggtcgtt cctgtgtggt

1121 gtggttggtg ggatgtgagc gggactggag tgaggccagc cgtggacagc agtgacagag gacagggcct
   caccacccac cctacactcg cctgacctc actccggtcg gcacctgtcg tcactgtctc ctgtccggga

1191 agggagtgtt gctttaaaga agggcaggag tcaaatgtcc aggggtggagg tgtgcggcca agggagagtt
   tccctcaaca cgaaatttct tcccgtcctc agtttacagg tcccacctcc acacggcgtt tccctctcaa

1261 gtgttaaaaa tgtgagatga cagggccggg cgtggtggct catgcctata atcccagcac tttgggaggg
   cacaattttt acactctact gtcccggccc gcaccaccga gtacggatat tagggtcgtg aaacctccg

1331 caaggcggat ggatcatgag gtcaagagat cgagaccatc ctggccaaca tgttgaaacc cgtctctact
   gttccgccta cctagtactc cagttctcta gctctggtag gaccgggtgt acaactttgg gcagagatga

1401 aaaaatacga aaattagctg ggcgtggtgc aggagaatct cttgaaccca ggaggcagag gtggcagtg
   tttttatgct tttaatcgac ccgcaccagc tctctttaga gaacttgggt cctcgtctc caccgtact

1471 gcgagatca cgcactgca ctacagcctg gtgacagagc aagacttctg cacacacagc cacaaaaaag
   cggctctagt gcggtgacgt gatgtcgac cactgtctcg ttctgaagca gtgtgtgtgc gtgttttttc

1541 tgagatgaca gctcatgttt agtgcggggt gctgggtgag cgagggtggg tgagcatcca tttccaggg
   actctactgt cgagtacaaa tcacggccca cgaccactc gctcccaccc actcgtaggt aaagggtccc

```

1611 gaggggcccc gcgcccattg agactgctgg ggacaggctg gggcagggcg ggggtggaggg tgtcctcttc  
ctccccgggg cgcggtacc tctgacgacc cctgtccgac ccgtcccgcc cccacctccc acaggagaag  
1681 tgatggatgc  
actacctacg

**Figure 6:** Complete sequence of pEpiGFP promoter clone #764. Maps to human Chromosome 2. Matches nucleotides 102210-103899 of Genbank Accession gi|14717362|gb|AC079400.6|[14717362]. Potentially important features noted within this region of chromosome 2 include an Alu repeat at position 102210-103899.

FIGURE 7

1 caagctttgc tatactgaa actcaaggtt gtctctgcta aatttcagta aacaattgtg aaagtcatga  
gttcgaaacg atatagactt tgagttccaa cagagacgat ttaaagtcac ttgttaaacac tttcagtaact

71 tgatggataa tcaactgtctg ctctacaggt ccactatcct atgacctcaat atgctgacct ttatgttctt  
actacctatt agtgacagca gagatgtcca ggtgatagga tacggagtta tacgactgga aatacaagaa

141 tgattttctg ttaggtttgg ccaatgggaa gcaacagcaa gagatggata gatggaagga gagagagctg  
actaaaggac aatccaaacc ggttaccctt cgttgctggt ctctacctat ctaccttctt ctctctcgac

211 gagaatttct ttccttacat cagttgggta gctgggcaga ttgactgggt ctgaaaccaa acacagggtc  
ctcttaaaga aaggaaatgta gtcaaccat cgacccgtct aactgaccca gactttgggt tgtgtccaag

281 agctacttgc cacttgcaag gtcaaaaatc aaggacaagg tgggggtgaa ggaaggaaaag gaatcgccaa  
tcgatgaacg gtgaacgttc cagtttttag ttctgtgtcc accccacctt ccttctcttc cttagcgggt

351 ggctttgtgc ctgaaaggaa ccatttcaaa tttctggata gaacgcaagg gcttaaaaaa ggagggttgg  
ccgaaacacg gactttcctt ggtaaagttt aaagacctat cttgctgtcc cgaatttttc cctccaacca

421 ggtgggaggg gcatgcaaga ggggcaagga ggtgccagtc agtctatgta agttgctctg atgacttgag  
ccacctccc cgtacgttct ccccggttct ccacggtcag tcagatacat tcaacgagac tactgaactc

491 ttattaccoc atctgttgaa cgggctggca ccatcccagg cacaatcggg gtgaaagcta actgcagctt  
aataatgggg tagacaactt gcccgacctt ggtagggtcc gtgttagccc cactttcgat tgacgtcgaa

561 tgagtaatct cctggaggag gagaattcca taggtaccta gattgtttca agactcagtc catgaacttc  
actcattaga ggacctctc ctcttaaggt atccatggat ctaacaaagt tctgagtcag gtacttgaag

631 caagaaaaa tataattaga tgagggggac attgtgcaag ggagtgcctg gtggaaggaa agagagcaaa  
gttcttttgt atattaatct actccccctg taacacgttc cctcacggac caccttctt tctctcgttt

701 ggttaccata taattttcaa gcatctaacc ataaagtaag caaggaggaa aatggaaaaa gattaaaaaa  
ccaatgggat attaaaagtt cgtagatttg tatttcattc gttctctctt ttacctttt ctaattttt

771 ttaaaaaat agtatttgggt tacatgtcct tgacctctg ctgaaggcca cagcttatga ccacctctc  
aatttttatc tcataaacca atgtacagga actgggagac gacttccggt gtcgaatact ggtgggagag

841 ctacagctac cagagtctcg gtttccagta actcgttgtt ccttctctg gctcatcagg ccaggaaatg  
gatgtcgatg gtctcagagc caaaggctat tgagcaacaa ggaaggagac cgagtagtcc ggtccttac

911 atagcagctt cctgttattg ctatcatgg ggtgtttcat tatctctgtt tatttttctt taactctact  
tatcgtcgaa ggacaataac gatcagtagc ccacaaagta atagagaaca ataaaaagga attgagatga

981 cactcctttg taaacagacc tttaactaat aactcttcac tctttccatc tgctttcagc cagaaccctg  
gtgaggaaac atttgtctgg aaagtgatta ttgagaagtg agaaaggtag acgaaagtgc gtcctgggac

1051 acctgctcag ccagaaactt cactgaagtt tctatagtc tcacgttcca ttagatctct agacttatc  
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1121 attctacata tctgcaactt tgtatcctt gatctgcac tccttatttc ctccctcctt ccccccaccc  
taagatgtat agacgttgaa acataggaaa ctgacgtag aggaataaag gagggaggaa ggggggtggg

1191 accgctggta accatcattt tgttctttgt ctttgtgtct tcgacatttt ttttttttta aagattacac  
tgccgacctt tggtagtaaa acaagaaaca gaaacacaga agctgtaaaa aaaaaaaaaa ttctaagtgt

1261 atttaagtga gatcatgcaa tatttttctt tctgtgtctg gatttttgca gtttcaggtc ttacatttaa  
taaatttact ctagtacgtt ataaaaagaa agacacagac ctcaaaacgt caaagtccag aatgtaaatt

1331 gcctttaatc cattctgagc tgattttgtg tgtggcataa gaaaagaatc ctattttata ttttattata  
cggaatttag gtaagactcg actaaaacac acaccgtatt ctttcttag gataaaatat aaaataatat

1401 tttcatttgg tttttaattt ttaatttcat caactgtgac tttgtgtat gaaaagagtg tgggtagcaa  
aaagtaaac aaaaattaaa aattaaagta gttgacactg aaacaacata ctttctcac acccatcgtt

1471 atctcttget ccactttgga aatccccctc cctcccacta aagtggagat tcctacctaa tctaactcct  
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1541 ggaggggtgt taacagagat taaaagagac agtgaagtgg acatgcttta aaataaaaaa gtgttttata  
cctcccaaca attgtctcta attttctctg tcaactcacc tgtaacgaaat tttattttta cacaaaatat

1611 agagaggcag cataatctgg agactcagag cacaggcacc agaggcaaca ctagggttga agctccagct  
 tctctccgct gtattagacc tctgagctct gtgtccgtgg tctccgttgt gatccaaact tcgaggctga  
 1681 ctgcctctga taaacttata atttaaatct gtgcctcagt ttccctcatat gtaaaatgag gataataaca  
 gacggagact atttgaatat taaatttaga cacggagtc aaggagtata cattttactc ctattattgt  
 1751 gatgtacctc ttagggttgt tgtcggagtt aaatgaaata taatattgcc tgatatatag taagttctca  
 ctacatggag aatcccaaca acagcctcaa tttactttat attataacgg actatatatc attcaagagt  
 1821 gtcagtggta cttttctttt tttttttttt ttttatgaga cagagtcttg ctctgttgcc caggctggag  
 cagtcaccat gaaaagaaaa aaaaaaaaaa aaaatactct gtctcagaac gagacaacgg gtcgacctc  
 1891 tgcagtggcg tgatctcgcc tcaatgcaag ctctgactcc caggttcaca ccactctcct gcctcagcct  
 acgtcaccgc actagagccg agttacgttc gagactgagg gtccaagtgt ggtgagagga cggagtccga  
 1961 cctgagttagc tgggactaca ggcgcccgc accacaccgc gctaaacttt tttgtatttt tagtagagat  
 ggactcatcg accctgatgt ccgcgggcgg tgggtgtggg cgattgaaaa aaacataaaa atcatctcta  
 2031 ggggtttcac cctgttagcc aggggtgtct cgatctctcg accctgtgat ccaccacact cggcctccca  
 ccccaagtgt ggacaatcgg tcccaccaga gctagaggac tggagcacta ggtgggtgga gccggagggt  
 2101 aagtgtctgg attgagaggt gacaatgtgc tagcagccct tgcttgcctc cggcacctcc tcaggccaca  
 ttacagaccc taactctcca ctgttacacg atcgtcggga acgaacgaga gccgtggagg agtcgggtgt  
 2171 ggcgtccactc tggctatgct cgaggagccc ttcagccgc cactgcactg tgggggcccc tctctgggct  
 cgcagggtgag accgatacga gctcctcggg aagtcggcgg gtgacgtgac acccccgggg agagaccga  
 2241 ggcacaggcc ggaactggct ccctctgctt gtggggaggt gtggaggag aggcgtggat aggaaccagg  
 ccgggtccgg ccttgaccga gggagacgaa caccctcca cactccctc tccgcaccta tcttggctc  
 2311 gatggggcgt gtgctcgtg gctagtgcga gttccaggtg ggcgggggct tggcgggcca cacttgaggt  
 ctaccgccc cagcagcacc cgatcacgct caaggtccac ccgccccga accgcgggt gtgaacctca  
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 acccagcggc tctgacggc cgggtacgct ctgtgcgaac ttaagagcga ccggagtcg gtggaggagc  
 2521 catggcaggc ctccgggact gcagcccgcc atgcctgagt tccctcgag tgggctccca cgcgcggga  
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 2591 ggttcccaaa cagctgcgc ccccgctcc accggaccca gtctcatcaa cagcccaagg gctgaggagt  
 ccaaggggtt gtcgacggc gggggcgaag tgccgtgggt cagagtagtt gtcgggttcc cgaactctca  
 2661 gcaggcaggc cgtgggactg cggggcagct ccgcccacgg gcctagtgtg ggatccacta ggaaaagtca  
 cgtccgtccc gcacccctgac cgcctgcga ggcgggtgcc cggatcacac cctaggtgat ccttttcagt  
 2731 gctgggctct tgagtgggtt ggggacttgg agaaatttta tgtctagctg gaggattcta tatgcaccaa  
 cgaccggaga actcagccca cccctgaacc tctttaaata acagatcgac ctctaagat atactgtggt  
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 agtcgtgaga cacagatcga gtcccaaaac ctaactgtgt tagtcgtgag acatagatcg attagaccac  
 2871 gggacttggg gaacttttat gtctagctag aggattgtaa atgcaccaat cagcactctg tgtctageta  
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 tcccttattt tctgtcgagc gaccagtcg tcgcccgttg gcgaaccag gggaaagtgc gacacctcgc aa



**Figure 7:** Complete sequence of pEpiGFP promoter clone #780. Maps to human Chromosome 5. Matches nucleotides 158043-154752 of Genbank Accession gi|18449986|gb|AC093240.2|[18449986]. Potentially important features noted within this region of chromosome 2 are discussed below.

## FIGURE 8

1 aagcttacat tctagtggg atgttagctt tgggggaaga ggctgtacca agcacatgcc tggaaacaggg  
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 71 aaggagctta aaaatatctg tggaaatgagt gactaaatgc ccagaatgaa tcagagggtga cactgcacaa  
 ttctcgaat ttttatagac accttactca ctgatttacg ggtcttactt agtctccact gtgacgttta  
 141 gttcagctgg tgggtaaaaa agaatactt gcttaaccca tccctgccca tgctccatcc catctcctt  
 caagtgcacc accattttt tcttactgaa cgaattgggt aaggagcgtt acgaggtagg gtaggaggaa  
 211 tcttcccgag agggccctcc tgctgtggtc caaggggcag ctggctgtgc agagagcagg cagacaccag  
 aggacgggtc tcccgaggag acgacaccag gtcccccgtc gaccgacacg tctctcgtcc gtctgtggtc  
 281 gctccaggac tgccaacctg gcaccgctgc ttggcgtctg gcgccctcta aaacaacaaa ctctgtgtct  
 cgaggtcctg acgggtggac cgtggcgacg aaccgcgacc cgcgggagat tttgttgtt gaagcacaga  
 351 ctaatttggc acttctgtt tatctttata ttatctctg tccctgaagc tcacaggctc aatcaaggat  
 gattaaaccg tgaaggacaa atagaaatat aatagaggac aggaacttcg agtgtccgag ttagtctcta  
 421 aatgcaaagg gccagaactt tggggactca gagatggaag aggcaagggt gccctctctg ccagggttct  
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 561 cctctgcacc tacacaacag gaagtccac atgctgggtt ctagtgttcc caggttcata gatcaatgcc  
 ggagacgtgg atgtgttgc cttcagggtg tacgacccaa gatcaacagg gtccaaagtat ctagttagcg  
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 tgaaaaaagg gagatgctta gaacaaaag acttggtgtg tcttatcctt cctaagtcgt cctcttaggg  
 701 ctagtctcac tgctgtctct ttctcatccg cacatggctt ggaatcactt cttaataaat gacttaactc  
 gatcgaagtg acgacagaga aagagttagc gtgtaccgaa ccttagtgaa gaattactta ctgaattgag  
 771 ctttcacagc ctttgagaaa tggatctaac tctgggtgct ttacctttt ttttttttt tttttttgag  
 gaaagtgtcg gaaactctt acctagattg agacccacga aatggaaaaa aaaaaaaaaa aaaaaaactc  
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 tccgaccaga gcttgaggac tggagggcac taggtgagta gaaccggaga gtttgtcgac cctaattgtc  
 1261 catgagccac caccatgcca ggctttttt tttttttct gagacagggt ctcttctgt ctcccaggct  
 gtactcgtg gtggtacggt cggaaaaaaa aaaaaaaaga ctctgtccca gagtaagaca gaggttccga  
 1331 ggaatgcagt ggtgtgatca tagctcactg cagccttgac ctccctgggt caggtgatcc tctacctca  
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 cggaggggtc atcgaccctg atgtccgtg gagtggtac ggttgattaa aaacatgaaa aacatctta  
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 1541 taaagtgcga ggattatagg tgtgagccac cgtggctgac tgccctcagg tttgttttt tttccagacg  
 atttcacggt cctaataatc acactcgtg gcaccgaccg acggagtcca aaacaaaaa aaaggtctgc

```

1611 gagtctcact ctgtctgagt gagaccagg ctggagtga gtggcatgat cttggctcac tgcaacctct
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1681 gcctcctggg ttcaagcgat tcttgtgcct cagcttccca agtagctggg actacaggcg cgcaccgcca
    cggaggaccc aagttcgcta agaacacgga gtogaagggt tcacgacccc tgatgtccgc gcgtggcggg
1751 tgcttggtta atttttgtat ttttggtaga gatgggtttt caccatgttg gccaggctgg tctcgaactc
    acggaccgat taaaaacata aaaaccatct ctacccaaaa gtggtacaac cggtcggacc agagcttgag
1821 ctgacctcaa gtgatccacc cactcggct tcccaaagt ctgggattac aggcataagc cactgcgcct
    gactggagtt cactaggtgg gtggagccga agggtttcac gacctaatg tccgtattcg gtgacgcgga
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    ccggaagtcc aagaacttag gtatgagatc cgtgaacttt ctacttcgaa

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**Figure 8:** Complete sequence of pEpiGFP promoter clone #841. Maps to human Chromosome 17. Matches nucleotides 133874-135813 of Genebank Accession gi|18874231|gb|AC018521.8|[18874231]. Potentially important features noted within this region of chromosome 17 include two L2 repeats at position 133776-133894 and 133918-133975, and four Alu repeats at position 134689-134853 (AluSg/x), 134856-135146 (AluSx), 135157-135454 (AluJo) and 135463-135767 (AluSx).

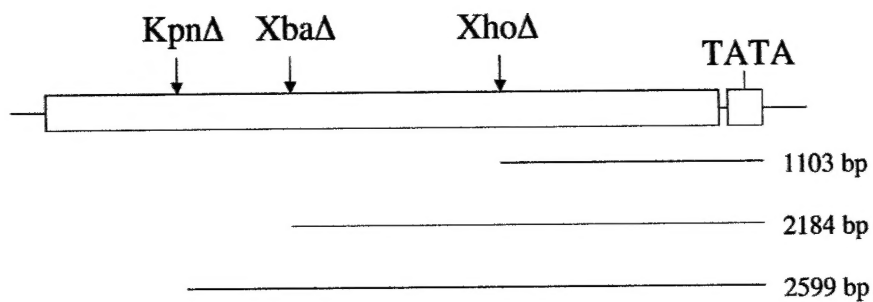
**Table III:** Activity of promoter clone 780 in various tumor cell lines

<i>Tumor line</i>	<i>Control</i>	<i>pTNF</i>	<i>pCMV</i>	<i>pRSV</i>	<i>p780</i>
K562	-	-	++	+	-
T24	-	+	+	+	+
293	-	-	+++	++	++
DU145	-	+	++	+	+
PC3	-	-/+	++	+	-

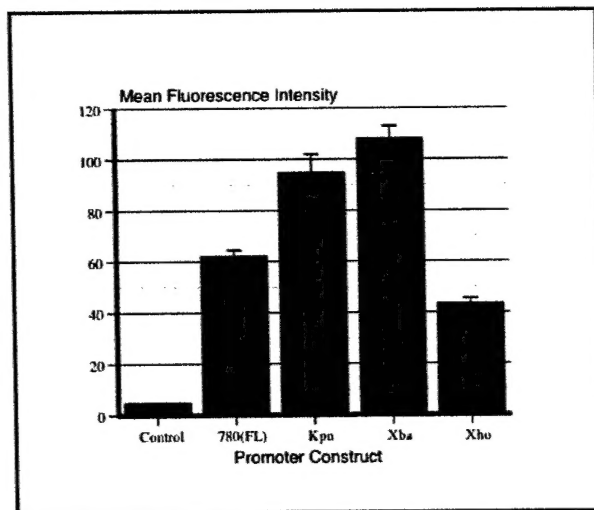
Promoter 780 and various control promoter constructs (CMV, RSV and TNF) were cloned upstream of a GFP indicator gene in an EBV-based episomal vector. Tumor cells were transduced by electroporation and GFP expression determined by FACS analysis.

## FIGURE 9

(A)



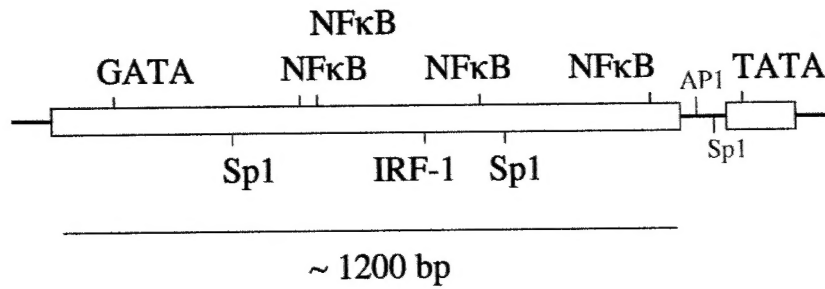
(B)



**Figure 9:** Deletional analysis of promoter clone 780. 5' deletions of the 780 promoter were prepared by restriction enzyme digestion and recloned upstream of the TATA box in pEpi(GFP) (A). Cells were transduced by electroporation and selected in G418. GFP expression was determined by FACS analysis (B).

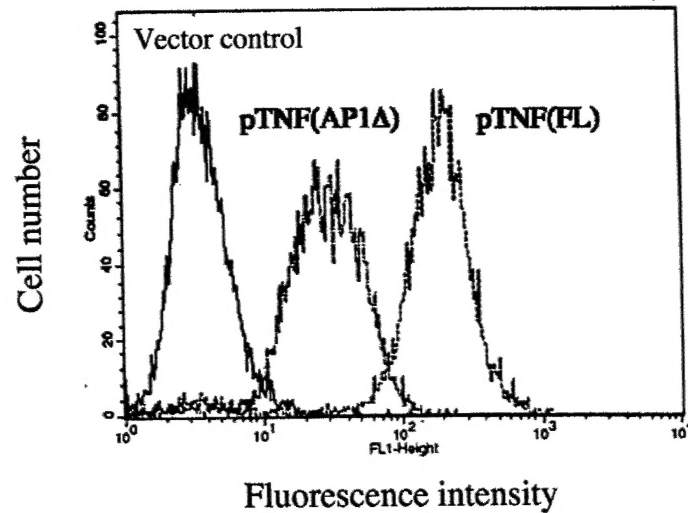


## FIGURE 10



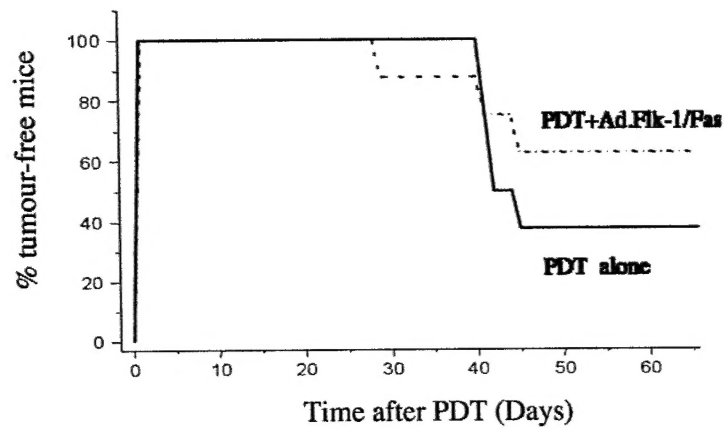
**Figure 10:** Human TNF- $\alpha$  promoter. The ~100 bp sequence adjacent to the TATA box containing an AP1 site and Sp1 site that appears to be responsible for the majority of the constitutive activity of element (see Figure 11) is indicated.

**FIGURE 11**



**Figure 11:** Activity of full length [pTNF(FL)] and AP1 deleted [pTNF(AP1D)] TNF promoter constructs in T24 cells. Promoter constructs were cloned upstream of a GFP indicator gene in an EBV-based episomal vector. Cells were transduced by electroporation and selected in G418. GFP expression was determined by FACS analysis. Removal of the AP1 site adjacent to the TATA box (see Figure 10) reduced promoter activity (as determined by mean fluorescence values) by 80-90% (note log scale).

**FIGURE 12**



**Figure 12:** DU145 tumor xenografts (~5 mm in diameter) growing subcutaneously in SCID mice received a single peritumoral injection of  $3.9 \times 10^9$  PFU Ad.Flk-1/Fas. 24 hours later tumors were treated with PDT (mTHPC 0.1 mg/kg; 30 J/cm<sup>2</sup>) and the impact of adenoviral-mediated gene transfer on tumor regrowth determined.